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(54) **CONNECTOR HAVING WIRELESS CONTROL CAPABILITIES**

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(51) **Int. Cl.**

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H02J 13/00	(2006.01)
H01H 9/54	(2006.01)
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CPC ***H02J 3/00*** (2013.01); ***H01H 9/54*** (2013.01); ***H02J 13/0075*** (2013.01); ***H05B 37/0245*** (2013.01); ***H05B 37/0272*** (2013.01); *Y02E 60/7853* (2013.01); *Y04S 40/126* (2013.01); *Y10T 307/944* (2015.04)

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CPC H02J 13/0075; H02J 3/00; Y02E 60/7853; Y04S 40/126

See application file for complete search history.

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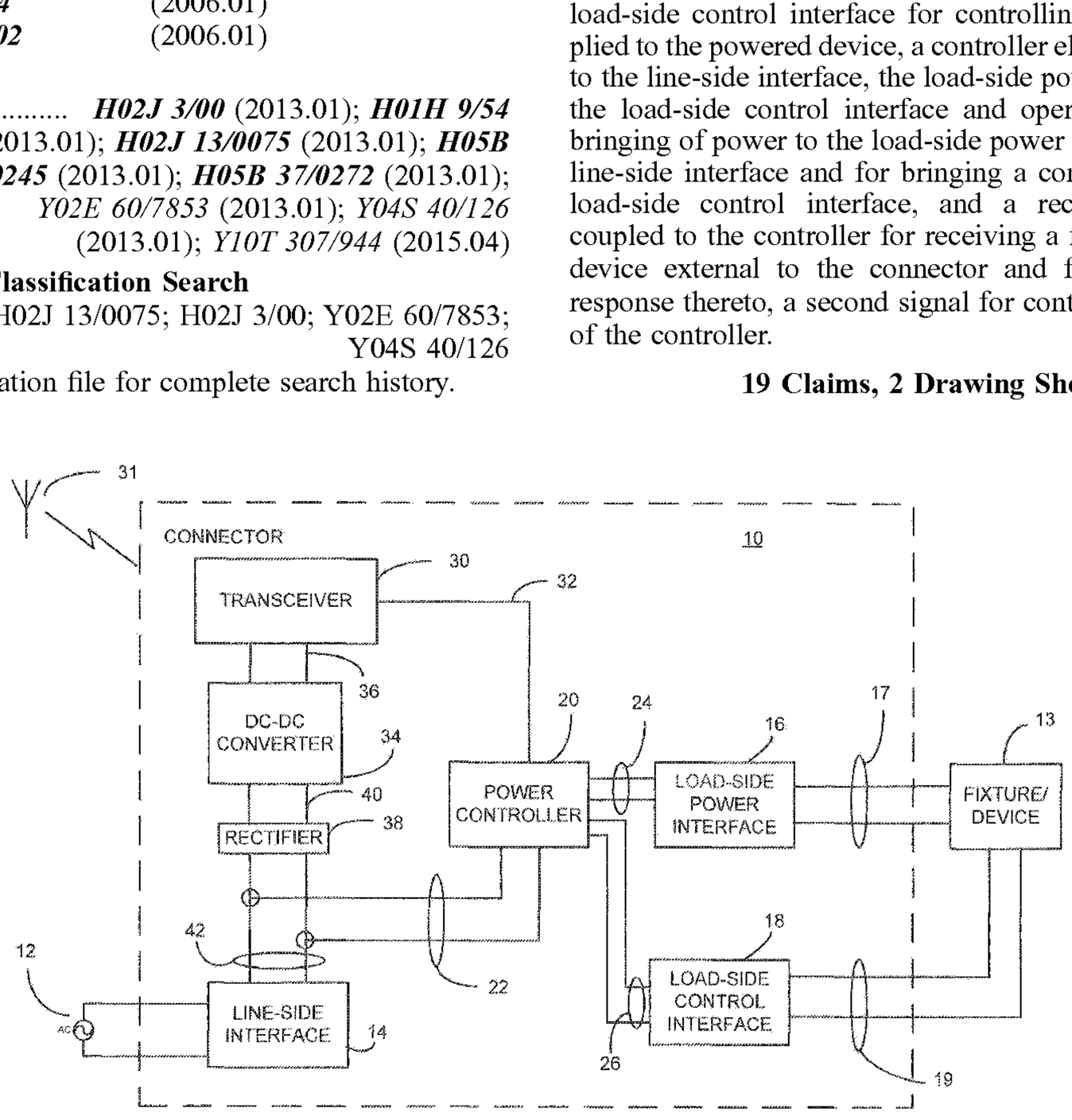
(57) **ABSTRACT**

A connector for connecting a source of AC power to a powered device includes a line-side interface arranged for releasably and electrically coupling the connector to the source of power, a load-side power interface arranged for electrically coupling the connector to the powered device, a load-side control interface for controlling the power supplied to the powered device, a controller electrically coupled to the line-side interface, the load-side power interface, and the load-side control interface and operable to control a bringing of power to the load-side power interface from the line-side interface and for bringing a control signal to the load-side control interface, and a receiver electrically coupled to the controller for receiving a first signal from a device external to the connector and for generating, in response thereto, a second signal for controlling operations of the controller.

19 Claims, 2 Drawing Sheets



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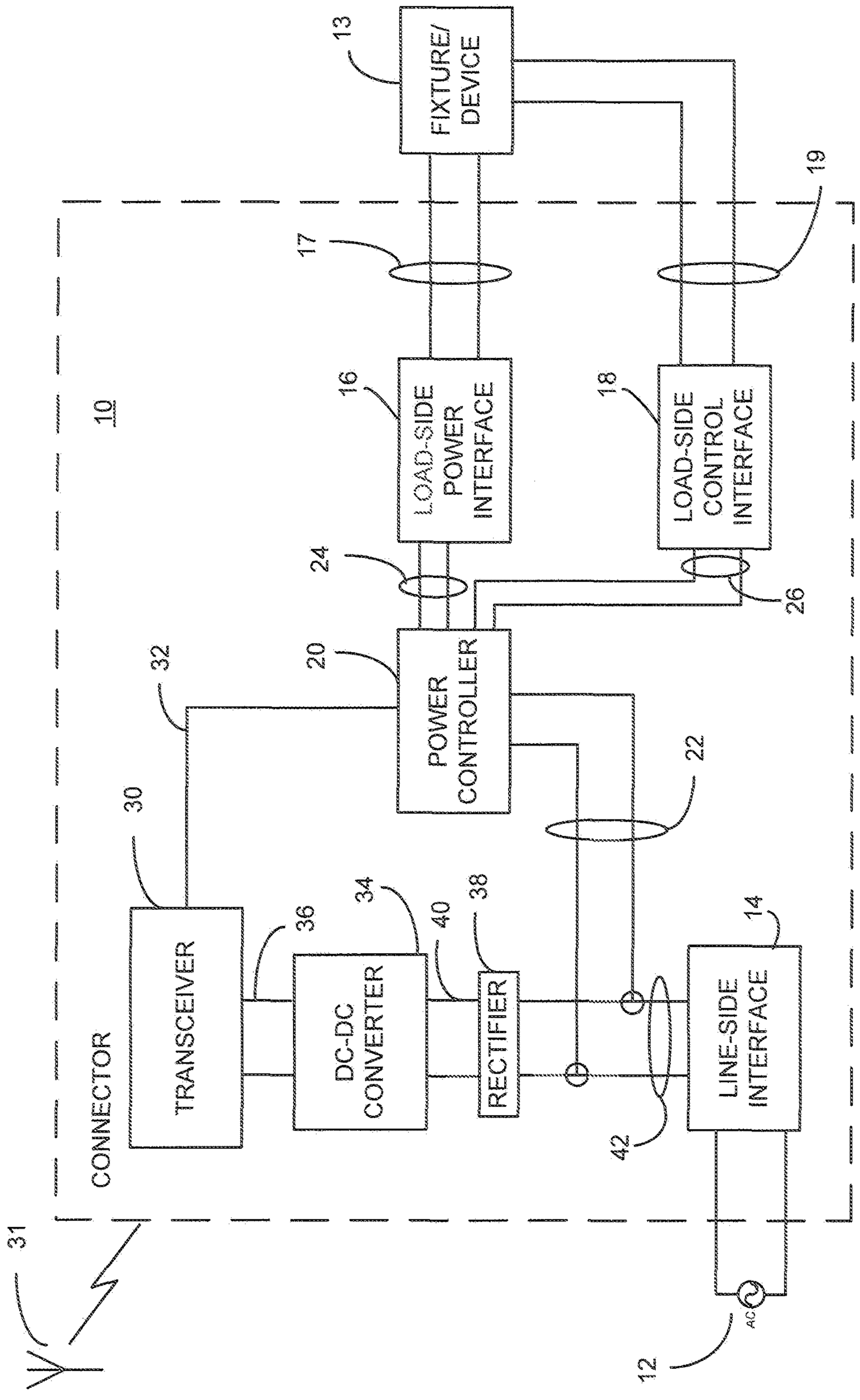
10
FIXTURE/ DEVICE
13
19
17
LOAD-SIDE POWER INTERFACE
16
LOAD-SIDE CONTROL INTERFACE
18
24
26
POWER CONTROLLER
20
22
32
30
34
38
36
40
42
14
TRANSCEIVER
DC-DC CONVERTER
RECTIFIER
LINE-SIDE INTERFACE
CONNECTOR
31
12
AC

FIG. 1

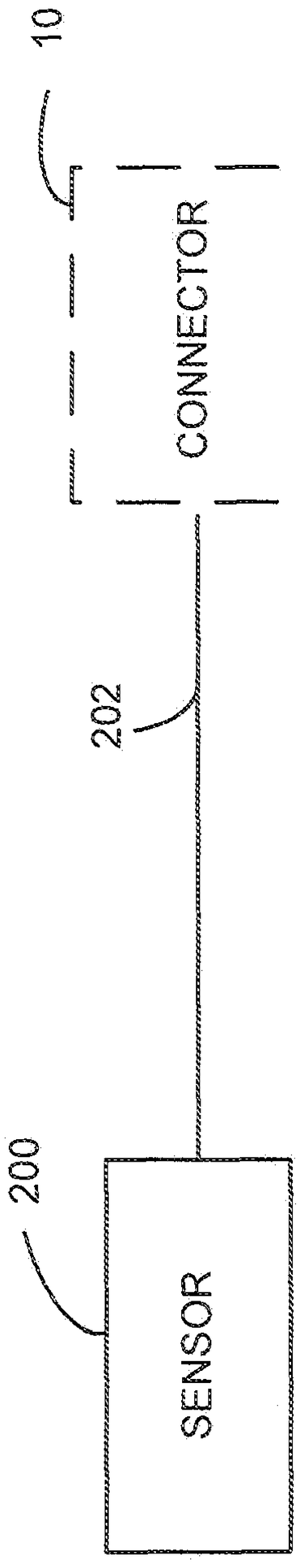

FIG. 2

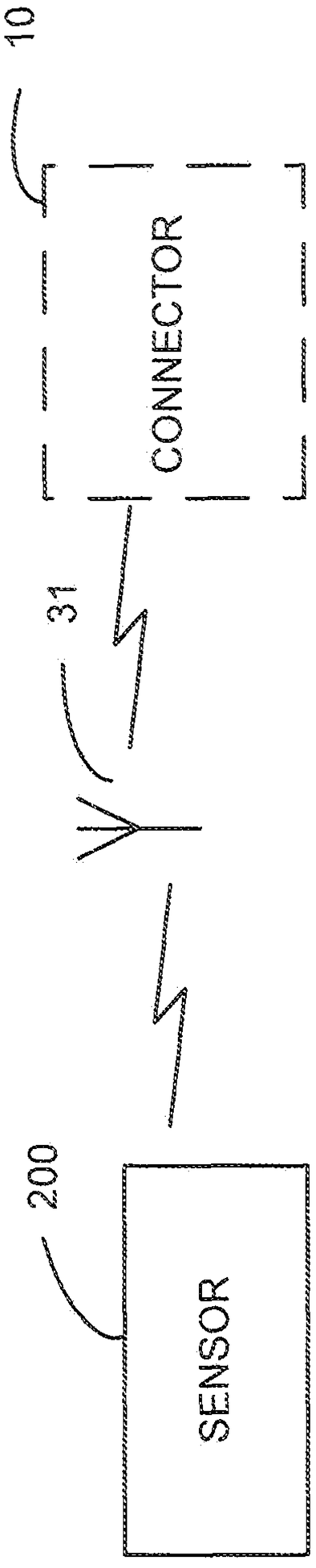

FIG. 3

CONNECTOR HAVING WIRELESS CONTROL CAPABILITIES

CROSS REFERENCE TO RELATED APPLICATION

This application is related to U.S. patent application Ser. No. 13/591,371 entitled "Connector Having Wireless Control Capabilities," filed Aug. 22, 2012, which is a non-provisional application claiming the benefit of U.S. Provisional Application No. 61/606,129, filed on Mar. 2, 2012, the disclosures of which are each incorporated herein by reference in their entirety.

FIELD OF THE DISCLOSURE

The present description relates generally to a wireless smart connector and more particularly to a connector having wireless control capabilities.

BACKGROUND OF RELATED ART

The subject disclosure is generally related to electrical connectors and, more particularly, to an electrical connector having wireless control capabilities for use in connection with an alternating current (AC) power system.

Systems for bringing low-voltage direct current (DC) power to low-voltage DC powered devices, such as light fixtures, sensors, or the like, are known in the art. By way of example, U.S. Pat. No. 7,997,910, U.S. Pat. No. 8,062,042, U.S. Pat. No. 7,679,222, and U.S. Pat. No. 7,762,821 (which patents are incorporated herein by reference in their entirety) disclose various grid systems that support conductive materials that are electrically coupled to a low-voltage DC power source and which provide contact surfaces that are connectable to low-voltage DC powered devices. These patents also describe various types of connectors that provide a means for coupling a low-voltage DC powered device to the contact surfaces of the grid system.

In addition, systems and methods of providing an adaptor for bringing wireless communication to a wired sensor include the use of a sensor interface, such as described in U.S. Pat. No. 8,275,471, U.S. Pat. No. 7,839,017, U.S. Pat. No. 7,925,384, US Patent Publication No. 2011/0043052, and US Patent Publication No. 2011/0043052. In at least one example, the referenced publications describe a system and method for enabling wireless communication with a wired sensor. In this example, power is continuously supplied to an electrical load device under control of a separate wireless controller. The wireless controller includes information stored and/or detected to directly control the electric load device.

Sill further, U.S. Pat. No. 6,990,394 describes a control system for allowing remote control of a load. In the described example, a light fixture includes a lamp controller which controls the operation of a lamp by selectively coupling the power source to the lamp. The lamp controller selectively operates the lamp in response to signals received from a remote controller and a light switch, as well as from a motion sensor and a photo sensor.

While the described connectors, systems and methods generally work for their intended purpose, the following describes an improvement to the known connectors for use in such similarly constructed systems.

SUMMARY

Described hereinafter is an improved push-in type connector which, among other advantages, has the advantage of allowing for wireless control of and the bringing of power to an AC voltage fixture. The connector is well suited for both retrofit/rehabilitation installations as well as for new construction. While not intended to be limiting, the subject connectors may be used to couple an AC powered device to any suitable AC powered wireless control system, to any suitable AC power cables, and/or to other disconnection/connection points in an AC power system. The subject connectors may be provided with one or more mechanical terminal structures, such as for example, push-in type terminal connectors, to thereby allow the subject connectors to be easily and releasably attached thereto.

While the foregoing provides a general description of the subject connector, a better understanding of the objects, advantages, features, properties, and relationships of the subject connector will be obtained from the following detailed description and accompanying drawing which set forth an illustrative example and which is indicative of the various ways in which the principles of the invention may be employed.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the subject invention, reference may be had to the following drawings in which:

FIG. **1** illustrates a schematic diagram of exemplary components of a connector having wireless communication capabilities.

FIG. **2** illustrates a schematic diagram of exemplary components of the connector having wireless communication capabilities including an environmental sensor directly coupled to the connector.

FIG. **3** illustrates a schematic diagram of exemplary components of the connector having wireless communication capabilities including an environmental sensor indirectly coupled to the connector.

DETAILED DESCRIPTION

Turning now to the FIG. **1**, a schematic diagram of an exemplary connector **10** for use in bringing power from a power source **12**, such as an alternating current (AC) power source to a powered fixture or device **13**, such as a light fixture, sensor, or the like, is illustrated.

For allowing the connector **10** to be coupled to the power source **12**, the connector **10** includes a line-side interface **14** comprised of one or more electrical contacts arranged to allow engagement with corresponding electrical conductors or surfaces associated with the power source **12**. The electrical contacts of the line-side interface **14** may be incorporated into a housing, such as for example a non-conductive housing, having mechanical structures as needed to allow the connector **10** to be releasably attached to a power grid system, power cables, and/or to other disconnection/connection points in a power system. While not limiting, the wireless connector **10** may also be attached to conductors, such as wires, associated with the source of AC power through use of insulation piercing type contacts (IPC type contacts), insulation displacing type contacts (IDC type contacts), push-in type contacts, crimp type contacts, weld type contacts, etc.

For allowing the connector **10** to be coupled to the powered device **13**, the connector **10** includes a load-side power interface **16** and a load-side control interface **18** comprising one or more electrical contacts (which one or more electrical contacts may be incorporated into the same or a further housing having mechanical structures as needed)

adapted to be engaged with wires **17**, **19**, respectively, plugs, or the like, that are associated with the powered device **13**. The example load-side power interface provides AC power to the device **13**, while the example load-side control interface **19** provide a control signal, such as for example, a dim, flash, brighten, chase, turn on, turn off, etc. control signal.

While the load-side power interface **16** and the load-side control interface **18** are illustrated in the present example as separate components, it will be appreciated by one of ordinary skill in the art that the interfaces **16**, **18** may be integrally and/or separately formed as desired. Additionally, each of the electrical contacts and/or wires **17**, **19**, may be otherwise combined and/or separated. Still further, without limitation, the electrical contacts of the load-side interface **16** and/or the load-side control interface **18** may be push-in type contacts, IDC type contacts, IPC type contacts, crimp type contacts, weld type contacts, etc.

To control the bringing of power from the line-side interface **14** to the load-side power interface **16**, and accordingly to the device **13** coupled to the load-side interface **16**, the connector **10** further includes a controller **20**. As illustrated in FIG. **1**, the example controller **20** is electrically coupled to the line-side interface **14** via an electrical connection **22** and is electrically coupled to the load-side interface **16** via an electrical connection **24**. In addition, to provide control instructions and/or signals to the load-side control interface **18**, the controller **20** is coupled to the load-side control interface **18** via an electrical connection **26**. By way of example only, the controller **20** may comprise a semiconductor based electronic device such as an Opto-isolator, silicon-controlled rectifier (SCR), field-effect transistor (FET), transistor, microelectromechanical systems (MEMS) switch, and/or any other suitable controller. Furthermore, as previously noted, while the load-side power interface **16** and the load-side control interface **18** may be integrally or separately formed as desired, it will be appreciated by one of ordinary skill in the art that the controller **20** may also be integrally formed with one or more of the interfaces as desired.

In this example, the controller **20** is further coupled to a receiver (e.g., a wireless receiver) or transceiver **30**, which, as described hereinafter, functions to provide a control signal to the controller **20** via an electrical connection **32**. Power is provided to the wireless receiver or transceiver **30** by means of an optional DC-DC converter **34**, which is electrically coupled to the wireless receiver or transceiver **30** via an electrical connection **36** and to the line-side interface **14** via a rectifier **38** having an electrical connection **40** to the DC-DC converter **34** and an electrical connection **42** to the line-side interface **14**. The wireless receiver or transceiver **30** may also be directly coupled to the line-side interface **14** and/or the rectifier **38** as desired. It will also be understood that other means for providing power to the wireless receiver or transceiver **30** could also be employed, such as by providing power through use of a battery, through use of ambient radio frequency (RF) power harvesting, or the like. It will also be understood that the electrical connections between the various components illustrated in FIG. **1** may be traces formed on a printed circuit board (PCB), wires, or the like without limitation.

More particularly, for controlling the bringing of power to the load-side interface **16** and/or for controlling the bringing of control signals to the load-side control interface **18**, the wireless receiver or transceiver **30** is adapted to receive and transmit a control signal (e.g., a DC control signal) to the controller **20** via the electrical connection **32** in response to the wireless receiver or transceiver **30** receiving a control signal from a remotely located device **31**, e.g., a switch, control center, or the like. In one example, the remotely located device and the wireless receiver or transceiver **30** are adapted to communicate via use of wireless RF transmissions. The controller **20** is, in turn, adapted to respond to the control signal transmitted thereto via the electrical connection **32** to control the bringing of power to the load-side interface **16** from the line-side interface **14** via the electrical connections **22** and **24**. Additionally, the controller **20** is adapted to respond to the control signal transmitted thereto via the electrical connection **32** to control the bringing of a control signal to the load-side control interface **18** via the electrical connection **26**.

In this regard, the control signal provided to the controller **20** by the wireless receiver or transceiver **30** is used to turn on or turn off the power connection between the load-side power interface **16** and the line-side interface **14**. Furthermore, the control signal provided to the controller **20** by the wireless receiver or transceiver **30** may also be used to provide a controlling signal to the load-side control interface **18** to limit and/or otherwise modify or control the amount of power that is provided to the device **13** e.g., to provide for a dimming effect. Specifically, in at least one example, the load-side control interface may reduce (e.g., dim) the output AC voltage by chopping the AC output for typical incandescent light. Still further, the load-side control interface may provide an analog (e.g., 0 to 10) volt variable output to dim fluorescent lights.

It will also be appreciated that, in the case when a transceiver **30** is utilized, the connector **10** may allow for state data associated with the controller **20**, and accordingly the device **13**, and/or other data to be communicated to other remotely located devices as needed. While not illustrated, the connector **10** may additionally include a mechanism or other means for allowing a user to set (or for pre-setting at a time of manufacture) an address to thereby allow communications to the connector **10**, via the receiver or transceiver **30**, to be specifically targeted thereto—which would be particularly useful in an instance where multiple connectors are intended to be used in a confined area.

Turning now to FIGS. **2** and **3**, for providing the connector **10** with environmental and/or status information, the connector **10** may be directly coupled to a sensor **200** via a communication link, such as for example, a wire **202** (FIG. **2**). It will be appreciated by one of ordinary skill in the art, however, that the communication link may be wireless, wired, and/or other suitable link as desired. For example, the sensor **200** may be capable of communicating directly with the transceiver **30** or may communicate directly with the controller **20**. Still further, as illustrated in FIG. **3**, the sensor **200** may be adapted to communicate directly with the remotely located device **31**, which in turn communicates with the connector **10** as described hereinabove.

In the example of FIGS. **2** and **3**, the sensor **200** may be adapted to sense an environmental condition, such as a temperature, motion, light level, time of day, etc., and communicate the sensed condition to the connector **10** (either directly or indirectly as shown) for influencing the ultimate performance of the device **13**. For example, the sensor **200** may detect an ambient light of the room in which the sensor **200** is installed and relay that the relevant information to the connector **10** for influencing the load-side power interface **16** and/or the load-side control interface **18**, which in turn influences the performance state of the device **13**. In this way, the connector **10** may be "smart" in that the

connector **10** is able to influence the performance of the fixture device to which it is connected in response to an external stimuli.

While specific examples of the present disclosure have been described in detail, it will be appreciated by those of ordinary skill in the art that various modifications and alternatives to those details could be developed in light of the overall teachings of this disclosure. It will therefore be appreciated that features described are not to be limited to any particular embodiment but may be freely used across embodiments where applicable. Additionally, it will be appreciated that the size, shape, arrangement, and/or number of components illustrated and described can be changed as necessary to meet a given need. Accordingly, the particular arrangements disclosed are meant to be illustrative only and not limiting as to the scope of the invention which is to be given the full breadth of the appended claims and any equivalents thereof.

What is claimed is:

1. A system, comprising:

a powered device having a powered device controller; and

a connector for connecting a source of alternating current (AC) power to the powered device, wherein the powered device is located external to the connector and wherein the connector further comprises:

a line-side interface having one or more electrical contacts arranged for electrically coupling the connector to a one or more corresponding electrical conductors associated with the source of AC power;

a load-side power interface having one or more electrical contacts arranged for electrically coupling the connector to a one or more corresponding power receiving electrical conductors associated with the powered device;

a load-side control interface separate and distinct from the load-side power interface having one or more electrical contacts arranged for electrically coupling the connector to a one or more corresponding electrical conductors associated with the powered device controller of the powered device;

a controller electrically coupled to the line-side interface, the load-side power interface, and the load-side control interface, wherein the controller causes the load-side power interface to be selectively coupled to the line-side interface to thereby control the providing of AC power from the source of AC power to the powered device via the one or more corresponding power receiving electrical conductors associated with the powered device and the one or more electrical contacts of the load-side power interface and causes a control signal to be provided to the powered device via the one or more corresponding electrical conductors associated with the powered device controller of the powered device and the one or more electrical contacts of the load-side control interface; and

a receiver electrically coupled to the controller for receiving a first signal from a controlling device external to the connector and for generating, in response thereto, a second signal for provision to the controller whereby the controller causes the load-side power interface to be selectively coupled to the line-side interface and causes the control signal to be provided to the load-side control interface as a function of the second signal provided thereto by the receiver.

2. The system as recited in claim **1**, wherein the one or more electrical contacts of the line-side interface are arranged for releasably and electrically coupling the connector to the one or more corresponding electrical conductors associated with the source of AC power.

3. The system as recited in claim **1**, wherein the one or more electrical contacts of at least one of the load-side power interface and the load-side control interface comprises at least one of a push-in type contact, an IDC type contact, an IPC type contact, a crimp type contact, and a weld type contact for engaging a corresponding one or more wires associated with the powered device.

4. The system as recited in claim **1**, wherein the control signal caused to be provided to the load-side control interface by the controller comprises an electrical signal for controlling an on/off power function of the powered device controller of the powered device.

5. The system as recited in claim **1**, wherein the control signal caused to be provided to the load-side controller interface by the controller comprises an electrical signal for controlling a dimming power function of the powered device controller of the powered device.

6. The system as recited in claim **1**, wherein the controller comprises at least one of an Opto-isolator, an silicon-controlled rectifier (SCR), a field-effect transistor (FET), transistor, and a microelectromechanical systems (MEMS) switch.

7. The system as recited in claim **1**, further comprising a rectifier electrically coupled to the receiver and the line-side interface for providing power to the receiver.

8. The system as recited in claim **7**, further comprising a DC-DC converter electrically coupled between the rectifier and the receiver.

9. The system as recited in claim **1**, wherein the receiver is directly, electrically coupled to the line-side interface which provides power to the receiver.

10. The system as recited in claim **1**, further comprising a battery for providing power to the receiver.

11. The system as recited in claim **1**, wherein the receiver is an RF receiver.

12. The system as recited in claim **1**, wherein the receiver comprises a transceiver.

13. The system as recited in claim **12**, wherein the transceiver is an RF transceiver.

14. The system as recited in claim **1**, wherein the receiver is provided with an address.

15. The system as recited in claim **14**, comprising an address setting device associated with the receiver.

16. The system as recited in claim **1**, wherein at least two of the load-side power interface, the load-side control interface, and the controller are integrally formed.

17. The system as recited in claim **1**, further comprising a sensor external to the connector and communicatively coupled to the connector for providing data indicative of a state of the sensor to the controller.

18. The system as recited in claim **17**, wherein the remote sensor communicates directly with the connector.

19. The system as recited in claim **17**, wherein the remote sensor communicates with an intermediate device, which in turn relays the data indicative of a state associated with the sensor to the connector.

* * * * *